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MINERALS EXPLORATION &
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ENVIRONMENTAL GEOCHEMISTRY

This brochure describes MEG's areas of technical expertise in mineral exploration and the application of exploration technology to the environmental industry. MEG has developed leading technologies in phytogeochemistry, and mercury & radon soil gas, which are described in an environmental context..

OVERVIEW

MEG is best known for its phytogeochemical services. This work has provided several published mineral and water exploration case histories that have become the foundation for several widely attended short courses on the application of phytogeochemistry in the natural resources industries.

MEG is also known for soil gas collection technology. Its proprietary GAS'm and GAS'r techniques have been used for precious, base metal, and uranium exploration, and more recently, several geothermal resource and environmental surveys.

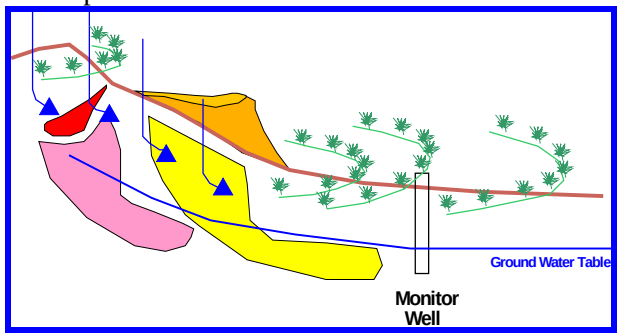
LATE DEVELOPMENTS

Various environmental issues in the United States and abroad have identified situations where exploration technologies are applicable. MEG is refocusing its leading technologies in phytogeochemistry and soil gases for use as subsurface mapping tools. For instance, the search for clean drinking water is intense. Phytogeochemistry happens to be a good predictor of ground water quality. So the application of phytogeochemistry to drinking water issues is a ready extension of the work MEG has been doing since 1984 in mineral exploration.

Mercury contamination is another issue which relates to the worldwide redistribution of natural occurrences. Manufacturing and mining are contributing to a global redistribution of this metal with many adverse repercussions. Phytogeochemistry and MEG's new mercury gas technology (GAS'm) will be useful in identifying sources of natural contamination and relationships to industrial point and non-point sources.

Uranium is another environmental hazard that can contaminate ground water above EPA maximum contaminant levels of 30 ug/L. Natural sources of ^{238}U, and daughter ^{226}Ra, can be located using phytogeochemistry and MEG's Radon Gas Method (GAS'r). Well-head protection and water quality studies can benefit from this information. Yerington, Nevada is an example of ground water exposure to naturally occurring concentrations of uranium and copper contamination.

Seismic activity is more apparent in the news. Phytogeochemistry and soil gas geochemistry are tools for the delineation of obscured subsurface faults that may reactivate, and may affect urban and commercial development.



Ground water quality can be adversely affected by seepage through naturally occurring mineralization and waste rock. Plant tissue analysis coupled with monitor well data can determine the extent of contaminant plumes. Soluble uranium and radium minerals decay to ^{222}Rn that can be detected from soil gas surveys.

The Arsenic Problem

In January 2006, the EPA reduced the maximum concentration of arsenic allowable in municipal drinking water to 10 ppb, causing difficulties for many water districts. The EPA estimates that 3,200 of the nation's 74,000 public water systems will require corrective action to meet this standard. Western states in particular will have great difficulty meeting this new standard due to widespread, naturally elevated concentrations of arsenic.

Phytogeochemistry

A cost-effective way of addressing the arsenic problem is to use phytogeochemistry to "prospect" for the cleanest possible water in regions where the quality of ground water is variable and not well understood. It has been repeatedly observed that high concentrations of arsenic in plants correlate with high concentrations of arsenic in groundwater as it interacts with mineralized bedrock and overlying sediments. Sagebrush, creosote, and other common rangeland shrubs found in the southwest U.S. are ideal plants for phytogeochemistry because they are widely distributed, and their phytogeochemistry closely matches the chemistry of underlying ground water.

An obvious advantage of phytogeochemistry over other techniques is that plants can be used to predict the chemistry of the underlying ground water prior to the major expense of drilling. In contrast, geophysical methods can indicate the presence of water, but cannot indicate the quality of that water. The two approaches can be used together to reduce the cost of finding significant quantities of high-quality water.

Because other metals can be reported along with arsenic at nominal cost, a broad characterization of the ground water can be established with one survey.

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EXAMPLE: Stagecoach, Nevada

Stagecoach is a rapidly growing residential and industrial community east of Carson City. Current municipal ground water supplies contain 5-20 ppb As, and cleaner water resources need to be found. Several phytogeochemical surveys were conducted to determine if the method could be used to predict water quality prior to drilling.

The survey along US50 demonstrated that As concentrations in sagebrush are detectable and variable.

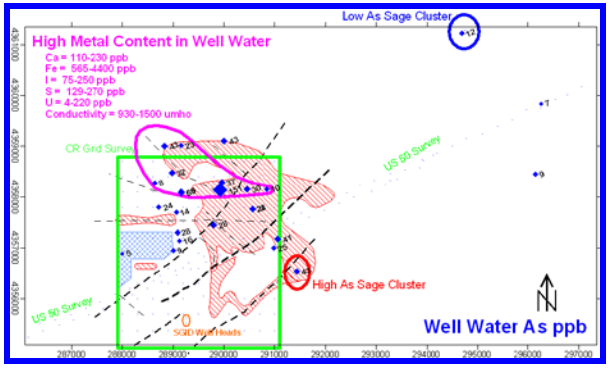
Detailed studies near a well with high As concentrations, and yet another with low As concentrations, related to As concentrations in sagebrush that were correspondingly high and low.

And, a grid survey of sagebrush on 300 m centers that covered an area of 16 Km2 showed that areas with relatively high concentrations of arsenic (above 200 ppb) are distinguished from areas of lower concentrations, and these relate spatially to As concentrations in ground water. Those portions of the survey area with the lowest phytogeochemical concentrations of arsenic and other metals were identified as those most likely to have the cleanest water resource.

The cost for these surveys was under $20,000. That is equivalent to about $1,500 per Km^2. By comparison, one cased 300 foot bore in unconsolidated gravels and alluvium costs about $90,000.

Conclusion

Phytogeochemistry offers a new, cost-effective way of predicting ground water quality prior to expensive drilling and conventional water resource development. Not only are geologic structures identified that may influence the flow of subsurface water in the hydrographic basin, but a full suite of elements is identified that may affect several aspects of water quality and water treatment.



Arsenic in sagebrush tissue (Pattern = As>200ppb) from the US50 Survey & Churchill Ranchos Grid. Geological structures (black) are interpreted from the phytogeochemical data. Area of cleanest water (blue) is proposed for municipal well. Domestic well water data shows spatial relationships to the phytogeochemical data. Area of "High Metal Content" shows other metals are also anomalous in the indicated area. An ancillary study demonstrated that well water with arsenic concentrations 30-50 ppb are associated with sagebrush tissue concentrations of >100 ppb arsenic.

SURVEY COSTS

Phytogeochemical, mercury, and radon soil gas geochemistry provides your exploration and environmental programs with valuable targeting information. MEG's proprietary methods are designed to detect deep bedrock and ground water sources. Rigorous phytogeochemical, soil collection, and collector burial protocols require experienced field personnel. MEG has the professionals that will assure your surveys are correct and smartly executed.

Consulting Services

Office ..... US $120 /hour
Field ..... US $1200 /day

Phytogeochemistry

See the Phytogeochemical Brochure for Preparation Costs

Mercury Soil Gas Geochemistry

GAS'm Prep & Analysis ……. US $18.90
Subsequent Desorptions (each) US $ 9.90

Radon Soil Gas Geochemistry

GAS'r Analysis …… US $21.00

See the Soil Gas Brochure for Preparation & Analytical Details

WORLDWIDE SERVICE:

As the mining industry has grown globally, so has MEG. We provide the best-known and respected phytogeochemical service in North America, and despite added shipping costs from remote exploration frontiers, MEG receives samples from around the world. We are also a preferred subcontractor for many major N.A. laboratories. Please note our import permits:

SOIL: P330-12-00341 (Expires 12-17-2015)
VEGETATION: PCIP-13-00190 (7-17-2015)

Permit and Quarantine Documents must be applied to the outside of all shipping containers. Please notify MEG prior to shipping for late information on USDA import requirements.

OTHER SERVICES

SAMPLE PREPARATION: Rock, Soil, Sediment,
PHYTOGEOCHEMISTRY
SURVEY & COLLECTION
GEOCHEMICAL INTERPRETATION
QUALITY ASSURANCE PROGRAMS
STANDARD REFERENCE MATERIALS

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